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Shipbuilding and the English International Timber Trade, 1300-1700: a framework for study using Niche Construction Theory

Jillian R. Smith

Abstract: Much scholarship has been undertaken with regards to the evolution of the European shipbuilding traditions and their physical changes, but few explanations for the changes are given. This paper seeks to identify the correlations between the expansion of the English timber trade in the fourteenth to seventeenth centuries and the changes in shipbuilding at the time, thereby creating a framework for future study of this correlation and its possible relatedness using Niche Construction Theory as a framework. Directions the research can take and the data needed are the focus of this work.

English trade has long been dependent upon the sea as the main thoroughfare for goods traveling to and from the island. Boats and ships of various sizes, shapes, and varieties have in turn, until the last century with airplanes and the Channel Tunnel, been the primary means of leaving England for any purpose. As such, during the Middle Ages, England began working toward creating a global naval network, first through trade networks and then through colonialization and conquest. The most marked expansion of English trade networks happened during the High Middle Ages and the early Renaissance, roughly encompassing the fourteenth through the sixteenth centuries.

This expansion of trade coincides with other relatively rapid and influential changes at the time: shipbuilding in Northern Europe and increasing urbanization of mercantile centers. Shipbuilding traditions are conservative by nature, and so relatively rapid change in hull construction and rigging systems are not commonly seen, but both of these happened during these 300 years. Historians tend to attribute this change in shipbuilding to a combination of factors, the main one being increased contact between the tradition of Northern Europe with the tradition of Southern Europe. Aspects of the Southern techniques are seen as superior to those used in the North, and may be borne out in

the persistence of Southern building techniques into the Golden Age of Shipbuilding, the seventeenth and eighteenth centuries (Gardiner and Unger 1994). While this is certainly a factor, there are others and the question remains: why change shipbuilding techniques?

At the surface, the above question is central to this paper. To answer this question, it will be useful to examine the change in shipping patterns, the structural changes to ships during this period, and the changing environments that were being brought into trade networks through their expansion and the quest for raw material trade goods. In particular, this paper will focus on the English international timber trade, which was essential to the building of the fleets of merchant ships and warships that were important to the continuation of English trade with the rest of the known world. This paper will also show how the conceptual framework of niche construction theory might be useful in expanding the discussion of this pattern of trade and change that was occurring at this time, specifically looking at the timber trade as the vector of change and the constructed niche.

This paper will discuss briefly the historical contexts and changes that took place in England and English international trade during the fourteenth, fifteenth, and sixteenth centuries and the change in Northern shipbuilding traditions that took place contemporaneously. A discussion of the environmental settings involved will also be presented. This paper will conclude with thoughts on if and how niche construction theory can be used in the context of historical trade.

English International Trade in the High Middle Ages

Throughout the medieval era, the primary trade good associated with English export was wool. The prominence of the wool trade is often seen in the power of the Mercer's Guild and the Company of Mercers, whom are sometimes credited with the founding of the Company of Merchant Adventurers (Bisson 1993:2). The Company of Merchant Adventurers came about in the early fifteenth century, with the royal charter of 1407, giving English merchants the right to govern and organize themselves in the Low Countries (Holland, Zeeland, Brabant, and Flanders) and was one of the first chartered trading companies in England (Bisson 1993:3). With the cloth trade as the backdrop for this first organization of English merchants trading abroad, the stage was set for the later trading companies to emerge.

Prior to the chartering of the Merchant Adventurers, English merchants would usually conduct trade as individuals. An individual merchant may have owned a small number of ships, but the merchant was predominantly left to his own devices. Trade was regularly conducted with the Low Countries, France, the German Hanse, and a few other countries (Bisson 1993). Goods coming from further east or

south than the Hanse generally had to pass through these on their way to England. During this period there was little collective bargaining for trade privileges, including monopolies and legal status, which were the hallmarks and backbones of the activities of the later English trading companies, as the German Hanse had been involved in such negotiations for decades at this time (Willan 1956; Bisson 1993).

As the English merchants became better organized during the fifteenth century, they came into more direct mercantile conflict with the continental powers, specifically the Hanse. It was this conflict and competition on the continent that aided in the development of a company for the exploration and initiation of trade relations east of the Northern Cape (Scandinavia) (Willan 1956). It was thought at the time that this would be the gateway to trade with the Far East, but instead turned out to be Russia. In 1555, the Muscovy Company was chartered, formally establishing trade and diplomatic ties with Russia and creating the first joint-stock trade company in England (Willan 1953, 1956; Bisson 1993).

Imported Russian goods were primarily raw materials, principally those associated with ship-building: timber, rope, and pitch. This would be an important source of these materials, as England had begun building the naval power that would become essential to its international dealings in the next few centuries (Willan 1956). Timber especially was one of the most important goods to which the English merchants had access at this time because domestic sources of timber were either mostly exhausted by this point, or were prohibitively difficult and costly to move around the country (Willan 1956; Masschaele 1993). The Irish sources of timber were also being exhausted through clearing and exporting to England. Having direct access to a source of timber, even being as far away as Russia, was still potentially more economical than relying on the Hanse for supplies from the Baltic areas. The timber in this case was usually pine, which could be sawn for planking, or kept whole for use as masts, yard arms, or any other number of uses, but oak was also exported from Russia to England. The crown usually claimed all or most of the timber in these shipments for its own use, and as the weather in the Baltic could claim one or more ships on the twice- or three-times annual journeys, the crown would commandeer entire loads of timber (Willan 1953, 1956; Bisson 1993).

An important aspect of the discussion of trade is the social relations of the merchants. When the trade companies were established and organized, a company house was bought, established, and maintained either at the usual port of call or in the political capital, or sometimes both, as was the case with the Muscovy merchants who were set up in Novgorod and Moscow. The location of the houses in the countries and cities could depend on a number of factors, but was

largely dependent upon the attitude towards foreigners. In Holland, the Merchant Adventurers were able to set up their houses and stores in Antwerp near where they did business. In Novgorod and Moscow, the house for the Muscovy merchants were relegated to the section of the city reserved for foreigners, as they were generally distrusted. (Willan 1956; Bisson 1993).

English international trade greatly and rapidly expanded once formalized trading companies emerged that were able to negotiate favorable trade agreements for members, protect members within the nations that were being traded with, protect property and trade rights from non-members, and create general funds through the establishment of joint-stock ventures (Bisson 1993). After the Muscovy Company in 1555, the Virginia Company and the East India Company came into being and helped expand English international trade further than it had ever been (Willan 1956; Bisson 1993).

Shipbuilding Traditions

Northern shipbuilding traditions of the High Middle Ages were all loosely based upon the earlier Viking tradition of a clinker-built open-decked hull with a side rudder and single mast rigged with a square sail (Hutchinson 1994). In the course of the study period, the side rudder was lost and steering was accomplished with a stern rudder and wheel, clinker-built planking was replaced by carvel-built planking, the number of masts increased, and a combination of sail shapes, both square and lateen were used by the end of the period (Gardiner and Unger 1994; Hutchinson 1994; Steffy 1994; Friel 1995). These changes will be detailed below, but this is a useful overview of the changes that occurred.

As described above, the vessels of the early medieval north were heavily influenced by the early medieval Viking tradition. The hulls of Viking ships, and Northern European ships for most of the study period were distinct for two reasons: clinker, or lapstrake planking and a shell first construction (Hutchinson 1994; Steffy 1994). Clinker-built, also known as lapstrake, refers to planking that is laid and fastened in such a way that a plank overlaps and is fastened the one immediately below it (see Figure 1 below). As will be discussed later, multiple layers of planking can be involved in this process as a vessel grows in size; when this occurs it is usually referred to as double- or triple-clinker (Hutchinson 1994). There is also a possibility that some ship types, like the hulk (which is notably absent from the archaeological record) used a "reverse-clinker" planking, which saw a plank overlapping the one on top in the opposite fashion seen in traditional clinker planking (Hutchinson 1994:11).

Shell-first construction refers to the actual construction

process where parts of the outer hull are put together before the inner framework is completely constructed, requiring the frame to be fastened to the shell of the hull instead of the other way round, which is called skeleton-first construction (Gardiner and Unger 1994; Hutchinson 1994; Steffy 1994). As can be seen below, building the frame of the ship before the shell would be quite difficult with lapstrake planking. Clinker-building still exists on a limited scale today, with the examples being fairly small boats. Medieval vessels built with this technique, or with the double- and triple-clinker variations, exceeded lengths of 30 meters (Hutchinson 1994:10).

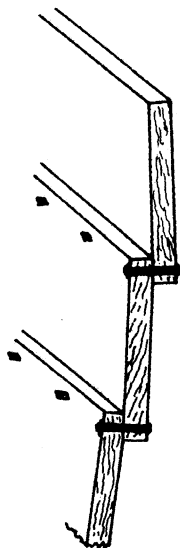


Figure 1: Traditional Clinker-built or Lapstrake Planking (Steffy 1994:100).

The simplest form of vessel in this case is known as the keel, in reference to the central baulk of timber at the bottom of the hull which was the base from which the ship was constructed (Hutchinson 1994). Lapstrake planking was then laid roughly horizontally from the keel between the stem and stern posts. Planks were not sawn for keels, but were split either radially from oaks or tangentially from softwoods (Hutchinson 1994:8). The manufacture of planking becomes an important point in later discussion of the growth in size of ships. These were ships that also had a single mast rigged with a square sail that sat near the middle of the vessel. Coins and town seals of the Viking era frequently show these kinds of vessels with a side rudder that was used for steering. There have been some archaeological examples of side rudders found, notably the one found with the Gokstad ship. (Greenhill

1976; Gardiner and Unger 1994; Hutchinson 1994; Steffy 1994). The keel was a fairly common ship type found and manufactured in England until well into the thirteenth century, when the Hanse cog appears to have gained popularity among the seafarers of northern Europe (Gardiner and Unger 1994; Steffy 1994).

The Hanse cog is possibly the most important ship type in northern Europe between the eleventh and early fifteenth centuries, when multi-masted carracks become the dominant ship type (Gardiner and Unger 1994; Steffy 1994). The cog is a ship that is double-ended with an angular profile, and a flush-laid planking bottom (planking laid side-by-side) with lapstraked sides (Steffy 1994:114, 120). Cog form reached its zenith in the thirteenth and fourteenth centuries when they were the primary ships in use by the Hanseatic League in overseas trade during this time (Gardiner and Unger 1994). Initially, cogs also utilized the side rudder, but later were fitted with stern rudders. Cogs were usually single-masted ships rigged with a square sail. As can be seen on Figure 2 below, the cog had a closed deck, which along with the profile and bottom construction distinguished it from the earlier keel. This enclosed deck also had the advantage of keeping trade goods drier than they would otherwise be in an open-decked vessel. Cogs also developed “castles,” which were both fighting platforms and enclosed housing for passengers built above the deck and by the fourteenth century, castles were considered integral to ship design (Gardiner and Unger 1994). The first castles were structures that were not effectively integrated into the hull design, but by the middle of the fourteenth century, fully integrated castles at both the stem and the stern of the ship were to be found (Gardiner and Unger 1994).

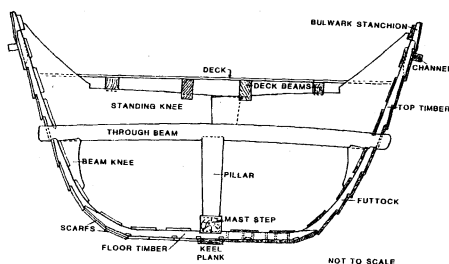


Figure 2: Midship Section of the Bremen Cog, 1380 showing hull planking. (Steffy 1994:119).

In spite of the presence and knowledge of cogs in England from the early thirteenth century, there have been no archaeological

finds of this vessel type in England, most of the finds are from Germany and other Baltic states (Gardiner and Unger 1994; Hutchinson 1994). The Bremen Cog, built around 1380 and re-discovered in 1962, is the most well-known example of this ship type and measured 24 meters in length. There is additional evidence from other wrecks that this may be an example of a mid-sized cog, rather than the maximum length (Gardiner and Unger 1994).

Cogs were adopted in the south of Europe, where they eventually morphed into the multi-masted carrack, possibly as early as the fourteenth century in the south of Europe, which was to become the starting point of much of the later European wooden shipbuilding tradition (Gardiner and Unger 1994). The carrack is the first instance of what is now considered a full rigged ship. These ships were much larger than the northern cogs and were built in the skeleton-first method of the south. In the north, when adopted, the hulls were still built with lapstrake planking and in order to compensate for the size of the vessels, the double- and triple-clinker planking was adopted, as seen in the case of the *Grace Dieu*, circa 1416 (Figure 3) (Gardiner and Unger 1994; Hutchinson 1994; Steffy 1994; Friel 1995). Carracks entered the English sphere around 1411 with the seizure of the ship *Sancta Maria & Sancta Brigida* from the Genoese, which was a two-master (Gardiner and Unger 1994). In 1416-1417, the English captured a further eight large (400- to 600-ton) carracks hired by the French, of which six were two-masters (Gardiner and Unger 1994:80). The *Grace Dieu* was the great warship of Henry V and was one of the first three-masted, possibly square-rigged, ships carrack in northern Europe (Gardiner and Unger 1994).

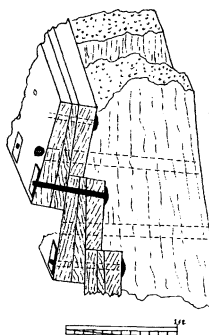


Figure 3: Detail of triple-clinker construction on *Grace Dieu* (Steffy 1994:114).

Carracks were ships that were built on previously unheard of scales, considered to be the largest in the fifteenth and sixteenth centuries, with lengths exceeding 38 meters and heights above the water line reaching 16 meters. However, from the middle of the fifteenth century into the sixteenth century, the numbers of the especially large ships decreases, both for the purposes of ease of access and for the financial benefit of splitting up cargoes between ships (Gardiner and Unger 1994).

With the multi-mast rigging of the carrack, the need for long, straight trees increased. In many cases, the main masts of these great vessels were composites of two or even up to four trees scarfed together and reinforced by a surrounding layer of smaller timbers (Gardiner and Unger 1994; Hutchinson 1994). Planking timbers by this time, and likely in the case of cog construction as well, were sawn instead of being split. Splitting strakes required tall straight trees with a regular grain to the wood, whereas sawing strakes did not and therefore allowed the previously less desirable trees to be cut down and used for ship construction. This ability to use more wood greatly aided in the exploitation of timber for the purposes of building larger ships. As mentioned above, there is reason to believe that the lapstrake planking method was not yet done away with at the time that the English were commissioning their first carracks, as the *Grace Dieu* was planked with the triple-clinker variant, but it is reasonable to assume that towards the end of the study period, lapstrake planking was being replaced by flush-laid planking, as this, combined with the adoption of the skeleton-first building, was the final major change in ship-building in northern Europe (Gardiner and Unger 1994; Steffy 1994).

While the carrack was an effective warship, it was also a very effective merchant vessel, though used primarily for traffic between the Mediterranean and the north. Carracks were able to carry a heavier burden of goods than previous incarnations of ships were, with the minimum tonnage of the carrack likely being somewhere between 300 and 400 tons and this being the usual maximum capacity of other English vessels at this point. The cargo hold of this type of vessel had from one to three decks, which necessitated the separating of the cargo at times for the purposes of easier loading. Because of their size, the ports where a carrack could be accommodated were limited (Gardiner and Unger 1994).

The caravel is the final ship type that deserves mentioning within the scope of this paper. Mostly being associated with the Spanish and Portuguese, these were skeleton-built ships with flush-laid planking, multiple masts and a combination of square- and lateen-sails (Gardiner and Unger 1994; Hutchinson 1994). Caravels were seen and built outside of the Iberian peninsula, and in these instances, such as the example of the caravel built for Philip the Good of Burgundy in

1438-1439, were square-rigged (Gardiner and Unger 1994:93). The combination of skeleton-built hulls with flush-laid planking was referred to throughout northern Europe as “carvel-built,” distinguishing it from the earlier tradition of clinker-built craft. The basics of the carvel-built tradition were what eventually took over in the north as the predominant style of ship-building for larger ships, leaving the clinker-built boats and cogs to the local specialized traditions (Gardiner and Unger 1994; Hutchinson 1994; Steffy 1994).

Sources of Timber and the Environment

As mentioned above, the period spanning the fourteenth to the seventeenth centuries was a period of greater urbanization than had been seen up to that point, even with the population decimations because of plague. Most local timber sources, or at least local to ship-building yards and centers, had long been harvested and what timber remained was almost unfailingly reserved for local use. Haneca et al. (2005), Daly (2004), and Daly and Nymoen (2007) investigate this phenomenon in the Low Countries and its implications for the continental trade. In their study, it became clear through provenancing timber from a variety of sources, including art historical, that there was a marked increase in the importation of Baltic timber into the Low Countries. The results of this study seem to indicate that there was a general eastward progression of Baltic forests being logged, as more western sources either ran out or ran short of the desired kinds of wood. Their study focused on oak, but it is possible that this could be the case for other varieties of wood (Daly 2004; Haneca et al. 2005; Daly and Nymoen 2007).

The same gradual deforestation had taken place in England, with the clearing of forests to create both new farmland and new pastures for livestock. It is reasonable to assume that a similar usage pattern to the one in the Low Countries at this time was adopted in England (Willan 1956; Bisson 1993). The confound in the English situation is that there were domestic sources of timber still available, but as mentioned before, they were prohibitively difficult to transport through the country. Because timber was one of the main reasons why trade with Russia was maintained even through difficult diplomatic times, it is likely that England was also highly dependent upon imported timber for both shipbuilding and other activities requiring timber (Willan 1956; Masschaele 1993; Lloyd 2001).

To allow for a better understanding of the local environmental factors at the time of the study focus, a more complete picture of the conditions needs to be developed. In England, and by extension any other area that was importing large amounts of timber, this would help to identify the factors of supply and demand: what is the timber needed

for, where does it come from, who is likely to use imported timber, and who is likely to use domestic timber? In the logging areas, the progression of logging sites through time would be an excellent study, including how access to sea lanes and rivers is maintained for transport of goods. It would also be useful to examine settlement patterns in connection with the logging areas, because urban or settlement centers may have been established or expanded with the rising prominence of the timber trade, such as Gdansk, and the effect of this upon both the trade and the region could be better understood.

Niche Construction Theory and Application

Niche construction refers to the process by which an organism alters its environment to better suit the organisms needs, thereby creating a new ecological inheritance for the next generation of organisms (Odling-Smee et al. 2003; Sterelny 2005). One way in which niche construction can take place is through the movement of an organism out of one place and into another. In these situations, feedback is introduced into the system where the organism is modifying the environment, because the organism is also then responding to the new environment that was created, and the cycle continues. There are any number of behaviors of any number of organisms that fit under the umbrella of niche construction.

Niche construction theory is a theory of triple inheritance, according to Sterelny (2005), and this may be the best framework within which to approach the problem of the timber trade. The three lines of inheritance are biological, ecological, and cultural. It is the cultural line of inheritance that holds the most promise for archaeological investigations using this theory. This framework of triple inheritance allows for the investigation into the interactions between culture, environment and the behavior of the individual to try and answer the larger questions in human history, or at least to investigate them in more complete ways than before. In the line of cultural inheritance, there is also the important addition of agency into the inheritance system of evolution, which is important to questions involving human actions, such as trade, domestication, and technology development.

In the application of NCT in archaeology, the lines of inheritance need to be identified in the given context, as does the niche constructing behavior. In many cases, the identification of these is not difficult, but the finding and interpreting of the archaeological data is difficult, as the concept of the "mere effect" (Sterelny 2005) must be taken into account. In the case of this paper, the changes in shipbuilding traditions have commonly been attributed to the increased interaction between the northern and the southern European traditions,

which is certainly a factor, but may just be a mere effect of the expansion of communication between the two regions. Conversely, the assertion of this paper, that the change in shipbuilding was motivated by the international timber trade, may be another example of a mere effect or be completely unrelated.

Discussion of Current Limitations and Future Directions

The three lines of inheritance in the case of shipbuilding are: the shipbuilding tradition, the extent of the English international trade, and the availability of timber resources. It is this last line of inheritance that is seen as the driving force for the changes that occur in the other two. The Northern European shipbuilding tradition, as described above, is roughly the same for England, with the possible exception of the cog, as there have been no archaeological examples of cogs found in England to date. There have been at least 46 ships found and excavated in England, of which perhaps half fall into the study period of this paper (Hutchinson 1994). In all cases, these remains are only partial, with some features of the ships having been lost immediately after the cessation of use, as is theorized to have happened to yard-arms, or having been lost due to taphonomic or discovery related processes, such as dredging. What this partial record leaves is gaps in the knowledge of how much wood a ship of a given style and size would have needed for construction, and this is a feature of shipbuilding that is not discussed in the analysis of medieval shipwrecks. The question of precisely how much wood was required for the building of ships may be difficult to answer, but there should be methods to find some answers, including a combination of experimental archaeology and historical research. In Europe, there is a tradition of building life-size models of ships known from wrecks using methods and tools as close to those of the appropriate time period as possible. In the building of these ships, discussions of the quantity of wood used, either in board-feet or other appropriate measure would do much to further the discussion surrounding the necessity of the timber trade and its expansion. Towards the end of the study period, treatises on shipbuilding are increasingly being written, published, and disseminated throughout Europe (Castro 2006). These treatises include a number of construction techniques, mathematical formulae, and proportions used in the planning and construction of ships (Castro 2006). If relatively accurate knowledge of the amount of wood necessary for a medium or smaller ship was known, it may be possible to reasonably extrapolate the resources needed for a larger vessel, creating a more complete picture of timber demands related to the shipbuilding industry in England. Additionally, it is possible through examination of the *Calendar of State Papers* of England, both domestic

and foreign, and other documents to determine the demand and commissioning of ships by type and size, at least by the crown. This will provide a partial context for the demand of particular ships over others, which may also help to narrow down the English tradition more than the general chronology given in this paper and by other authors. By having a more accurate understanding of the demands, then questions regarding supply may be more easily investigated and relationships between demand and the means and methods of supply may be examined with greater success.

The assumption in this discussion is that as English shipbuilders became more dependent upon foreign sources of timber, that ships they built became larger to accommodate the increasing size of the shipments. Separately, both the trend towards larger ships and the trend toward a greater dependence on foreign timber were in effect from the fourteenth through the sixteenth centuries. The question remaining is how did one affect the other? Bigger ships require more timber, but ships built toward the end of the study period in the skeleton-first method required on average less timber than those of similar size using the shell-first method (Gardiner and Unger 1994). However, the ships built toward the end of the focus period were larger than those built earlier and by the earlier method, negating much of the overall economy of resources. In both of these instances, research into the timber requirements for a full ship would greatly enhance discussion of this relationship. Alistair Roach (2008) believes that this research may be able to be conducted using shipbuilders' models created in the period, but an acute lack of writing about and research into these resources presents the same problems as the sole use of the excavated shipwrecks.

Archaeological evidence of the use of foreign timber is likely to be most successfully found in dendro-provenancing studies of the type conducted by Haneca et al. (2005) and in the continued efforts to create regional dendrochronologies. Historically, use can usually be inferred from shipping manifests. The timber resources available domestically or locally are very important to this discussion, but may also rely on the dendrochronologies being developed to complete the picture of the gradual deforestation of England near the coasts most heavily involved in shipping. The dendrochronological evidence will be the most important to establish the environmental changes taking place in England and in the foreign sources of timber as a result of the timber trade.

Conclusions

There are a number of interrelated changes taking place in English trade history, English shipbuilding, and the broader European

environment between 1300 and 1700. Separately, all of these changes have evidence as to their existence in the historical record, the archaeological record, or both. With increasing and improving dendrochronologies and the resulting dendro-provenances, the European timber trade is being mapped more completely. The excavation of medieval shipwrecks and shipyards allow for the techniques and forms of shipbuilding practiced to be better understood.

The study of maritime trade in England, and by extension Europe or any other maritime power, could be greatly enhanced by combining these lines of research and looking at the shifting sources of exploitation of raw materials, such as those for the timber trade. A framework based upon niche construction theory allows for the study of the combination of influences from the shipbuilding, the trade, and the environmental sources of raw materials. At this point, it is difficult to speculate upon what beyond the framework of investigation that niche construction can offer to maritime trade history, but with time and the expansion of data sets of the necessary kinds, it may be possible to supplement many of the existing theories for change with more nuanced and complete ones.

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